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Study of Distinguishing Metallic and Ionic Lithium in a Lithium-Ion Battery by an In Situ Imaging Technique with Muonic X-rays

Repeated recharging of lithium-ion batteries leads to the deposition of metallic lithium (m-Li) on the anode surface. Visualizing the spatial distribution of m-Li is challenging with existing techniques. Furthermore, lithium can also be deposited in the form of insoluble salts (s-Li) within the battery, making it essential f for visualization methods that distinguish between these two lithium forms. In our study, we aim to develop a novel elemental imaging method based on muonic X-ray analysis. As a fundamental investigation, we conducted measurements at PSI to compare the muonic X-ray intensities of m-Li and s-Li compounds such as LiF and Li_2CO_3. Our results show that the muonic X-ray intensity of m-Li is approximately 10 times greater than that of s-Li.
Additionally, we identified that the muonic X-rays generated in the surrounding air constitute the primary background. Our newly designed experimental setup can effectively reduce this interference, significantly improving detection sensitivity.

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